

Bioinformatics and Intelligent Systems

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The Bioinformatics, Intelligent Systems and Educational Technology (BISITE) Research Group is formed by a number of researchers whose principal interest is the development and application of intelligent computer systems to different types of problems: AI, ML, Deep Learning, Emotional Systems, Fintech, Blockchain, IoT, Industry 4.0, Smart Cities, Smart Grids, Intelligent Textiles, Biotechnology, among others.

BISITE has around a hundred members with a very wide range of professional backgrounds: computer scientists, biologists, pharmacists, physicists and economists. This gives the group its multidisciplinary character. The group collaborates intensively in more than 50 research projects with companies, universities and research centres. The work done by this group has an eminently practical component, nevertheless it does not miss the theoretical aspects which are the backbone of any research. The BISITE research group is responsible for the development of the IoT Digital Innovation Hub. Moreover, it coordinates a number of highly successful postgraduate courses in the fields of its expertise. Also, its members are in charge of organizing several international congresses [1-55].

BISITE has numerous projects in the field of Bioinformatics or Biotechnology. As part of those projects the group is engaged in the development of intelligent systems, of software applications and hardware elements. Some of the projects in which Bisite participates are listed below.

HERMES: The HERMES project (Hybrid Enhanced Regenerative Medicine Systems) has been financed by the European Commission which granted it 8450000 Euros from FET funds. The aim of the project is to develop a new paradigm in the world of medical implants [56-87]. HERMES focuses on the development of bio-hybrid implants, which consist of a biological component (stem cells) and an electronic component (a nanotechnology implant); the development of both components is coordinated by artificial intelligence designed by BISITE. This AI system monitors the behaviour of the brain and the implant in order to adapt the response of the latter.

Smart-LAMP: SMART-LAMP is a DNA amplification device. It has been developed by BISITE in collaboration with the e-INTRO Group and the FIW consulting company [88-167]. This device allows for the diagnosis of tropical diseases in situ. To do so, it makes copies of the genetic material contained in the sample and analyses the resulting turbidity. This automated system consists of three independent modules, which work together to provide the services of sample identification, processing, storage and sending of geolocated signals. **Neurostimulator:** The aim of this project is to design a PCB which will generate impulses to neuromodulate peripheral nerves in experimental animals. Its design will ensure a simple, reliable and economical means of inducing electrical stimuli in the vagus nerve by means of a microelectrode which has the shape of a clamp and is placed in the cervical portion of the vagus nerve.

SAPO: SAPO (Active System of Odorant Presentation) is a device developed in collaboration with the Institute of neuroscience of Castile and Leon. It makes it possible to carry out studies on neurodegenerative diseases using rodents as animal models.

This device has an odour presentation chamber through which an air current flows with substances that may have an odour or be odourless [168-221]. SAPO enables a quantitative, robust and reliable evaluation of the olfactory capabilities of laboratory animals, mainly the detection threshold and the ability to discriminate all types of odour substances.

BISITE-Genetics: To facilitate the diagnosis and treatment of cancers and rare diseases we are developing software based on Artificial Intelligence for the analysis of the patients' genome. With this tool we can detect the variants and mutations that a patient has and predict the pathology that he/she may suffer and the possible treatments.

Tinnitus: Tinnitus is a condition in which the patient perceives a beeping noise that does not come from the outside, but instead is generated in the ear itself or in the auditory nerve. Although there is no definitive cure, it can be controlled so that the sufferer may lead a relatively normal life. Since the diagnostic and follow-up tests are complex, the BISITE research group, at the University of Salamanca, has developed a simple device for self-assessment at home, enabling doctors to have more data about the patient's condition. Follow-up is more accurate and doctors have more data about the condition of people suffering from tinnitus. This is a great contribution to healthcare because it is much cheaper than the tests carried out by the specialist, and because it facilitates the follow-up of a group of patients who, due to the characteristics of this condition, tend to become distressed and, in the more severe cases, fall into depression because they cannot lead a normal life.

The device consists of a specialized hardware system that is connected to a smartphone for data processing and visualization. It consists of an external hearing aid and a bone transducer, which makes it possible to carry out tests both through the external and internal hearing aid, allowing for the identification of the origin of the problem. Once the data has been collected, a mobile application represents them graphically. This allows the patient to easily determine their hearing levels, estimating the degree of severity of tinnitus.

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